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Chromatic Gradient Appliance Algorithm In Cog Flank Dyeing For Its Flecture Angle Visual Estimate Acquired By Solid State Modeling Method.

V IU Karacharovskiĭ*, MK Reshetnikov, SA Riazanov, VV Shpilev, and SV Borodulina.

Gagarin IU A Saratov State Technical University, Saratov, 77 Politekhnicheskai͡a St.

ABSTRACT

Solid-state geometrical modeling of spatial cog gearings shaping technological processes method in 3D space is used. Work and transitional cog surfaces are formed as enveloping curve exerting tool models. As a result of workpiece and tool mutual surface traverse, final cog surface forms in the form of exact computer solid-state model. Three-dimensional solid-state modeling method is used for shaping flanks of worm screw and worm wheel. Visual analysis method for initial cog flank surface visual curvature estimate is applied.
Keywords: technological process, solid-state modeling, virtual shaping, surface intercrossing, Boolean diminution operation, worm-gear drive.

**Corresponding author*

INTRODUCTION

Currently gearing drives are applied in majority of cars and gears. Wide circulation of such drives is explained by their safety in operation and high bearing ability. Correctly calculated and collected cog and worm gears can work for theoretically unlimited and practically very long time.

Spatial screw gears gearing, such as worm with a cylindrical worm screw, globoid and spiroid, are widely applied in majority of modern cars and gears. Worm gears are widely applied in metallurgical equipment (in rolling mills press gears), in drive gears and various machine equipment kinematic chains (including gear-making), etc. Multiple-thread worm gear use helps simplify kinematics in many cases, increase reliability, reduce outline dimensions, reduce labor input of drive gear production. Increase in screw number and drive module is the simplest way to promote working speed body and admissible efforts and, therefore, machine productivity (car).

Main advantages of worm gears are:

- possibility of receiving large reduction ratio;
- large reduction ratios;
- possibility of self-slowing-down pairs design (at low efficiency);
- lack of vibrations;
- smooth and noiseless work.

Among disadvantages there are low efficiency and need to apply expensive anti friction materials for worm wheels.

Worm gears are applied to drive rotary motion from worm screw to a wheel when shafts of the leader and conducted in bulk are crossed. Usually the shafts crossing angle is equal.

Basic worm gear elements are worm screw and worm wheel (usually, conducted).

Worm gear reduction ratio equals to relation of worm screw revolutions number to worm wheel revolutions number or worm wheel cogs number to rounds number (screw number) of worm screw.

Currently great success in worm gears geometry study is achieved and there is a considerable progress in area of its production. Yet inevitable errors occur in body frame production and assembly for worm drives,. Meaning, for any real cog gearing the associativity of cogs work faces is rather a mathematical need, than a practical result [1].

WORM GEARS CLASSIFICATION

Worm gears in worm screw form divide into drives with cylindrical and globoid worm screws. Cylindrical worm screws in cross-section form divide to Archimedes, convolute and evolute, and by screw number – to single-thread and multi-thread (figure 1).

Fig. (1). – Worm gears classification

Currently in connection with ECM introduction into production process, there was an opportunity to raise a question about revision existing calculation of cog gearing methods, including screw, for the purpose of various approximate mathematical calculations replacement by methods, theoretically exact and most general, allowing to resolve issues of gear gearings design in a complex and variational way. Application of modern CAD/CAM/CAE systems allows to receive three-dimensional geometrical model completely coinciding with theoretical model. Yet, creating such models demands application of simpler design ways since in shaping it it is possible to consider design features of its production on particular cog-making machine. Creating such methods allows to reduce sharply labor input calculation, to increase accuracy and to reduce subracing works to a minimum during product installation. On final design stage the exact product three-dimensional prototype turns out. [2]

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ALGORITHM OF WORM GEAR ELEMENTS THREE-DIMENSIONAL DESIGN

Figure 2: Algorithm of virtual three-dimensional pilot model worm screw and worm wheel shaping

Figure 2 shows virtual shaping of worm-and-worm pair elements general algorithm. It can be divided into 5 stages:

1. Tool solid-state models designing or choosing from the existing virtual tool database (this database is associated with tools available at an enterprise) [3] (block 1.1);
2. Design of worm screw workpiece or worm wheel taking their geometrical parameters into account (block 1.2);
3. Mutual model installation of tool and workpiece taking into account drive design features (blocks 2 and 3);
4. Virtual worm wheel cogs or worm screw shaping (blocks 4 and 5);
5. Acquired results analysis (block 6).

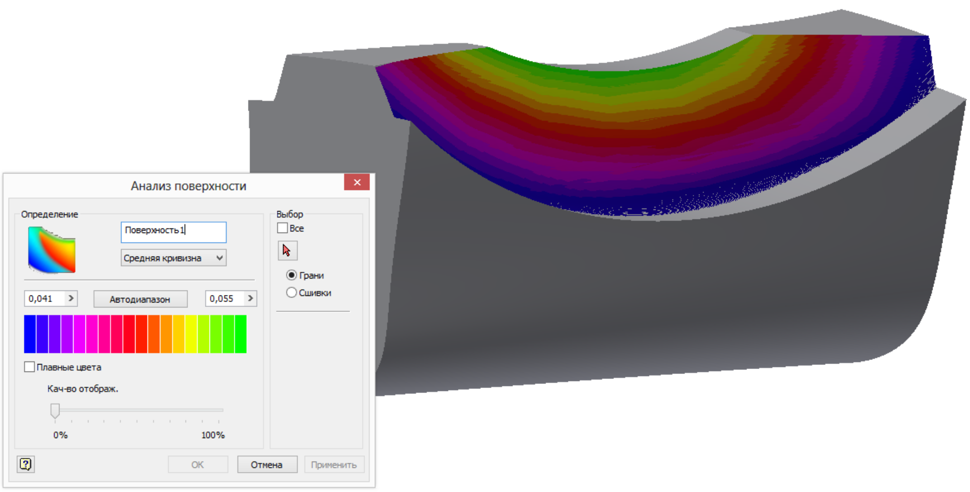
ASSESSMENT OF THE WORM SCREW AND WORM WHEEL FLANK ACCORDING TO AMOUNT OF CLEARANCE AND SURFACE CURVATURE

On wheel cogs surface virtual shaping stage it is possible to estimate quality of the surface acquired. Cog surface visual assessment application allows to avoid long calculations on already low-quality worm wheel model.

Figure 3: The solid-state model of worm wheel ring gear fragment acquired by method of "virtual cutting"

It is possible to relate amount of clearance between worm screw round flank and worm wheel cogs to one of the main characteristics [4]. Defining the amount of clearance can be carried out by auxiliary surface secants creation, as shown in figure 3.

Other mode of flank quality assessment is determining its curvature. At the stage of worm wheel flank curvature preliminary estimate it is possible to apply curvature visual allocation algorithm by Gauss method (figure 4). This method allows to mark out visually Gaussian, minimum, maximum surface curvature , and also average curvature on U and V shafts. The maximum curvature and positive Gaussian values are displayed in green color; the minimum curvature and negative Gaussian values — in blue.



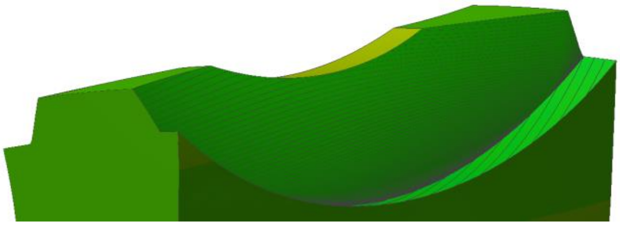


Figure 4: Cog surface assessment by surface curvature analysis application

CONCLUSIONS

As shown in figure 5, the exact digital pilot model of product allows to receive algorithm of three-dimensional solid-state modeling and to simulate its work [5, 6].

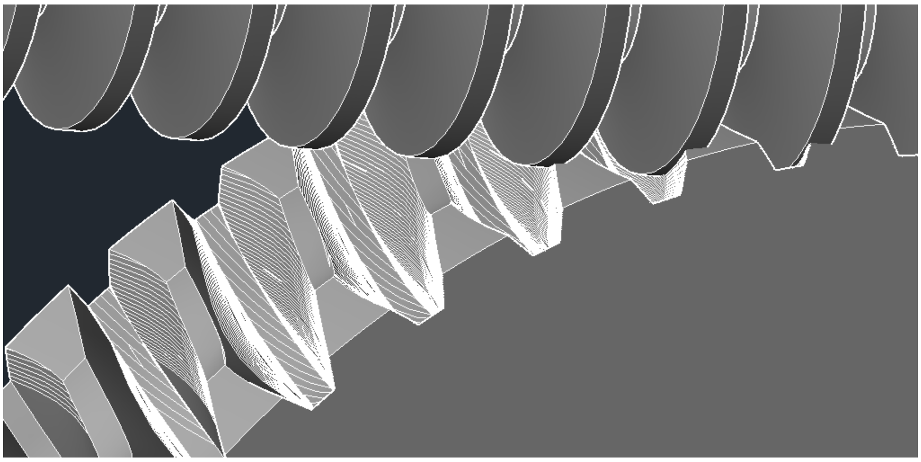


Figure 5: Shaping of worm wheel tool flank

Based on the above material it is possible to draw a conclusion that solid-state modeling method application allows to estimate visually curvature and continuity of worm wheel cog flank.

SUMMARY

Thus, visual control data of worm screw rounds flank geometrical characteristics and worm wheel cogs allow to quickly enough and objectively estimate indicators of worm gear geometrical and kinematic characteristics choice correctness. Based on above stated it is possible to draw a conclusion on prospects of task solution offered algorithm and on possibility of its application in calculating worm, as well as other types of cog gearings.

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